

Application No. 10/659,494
Response to Office Action

Customer No. 01933

R E M A R K S

Reconsideration of this application, as amended, is respectfully requested.

RE: THE TITLE

The title has been amended to more clearly indicate the nature of the invention to which the claims are directed, as required by the Examiner.

RE: THE OBJECTIONS TO THE SPECIFICATION AND DRAWINGS

The specification has been amended to correct minor informalities of which the undersigned has become aware, including all of the informalities pointed out by the Examiner.

In addition, the specification has been amended to refer to reference character "G" as required by the Examiner.

And it is respectfully pointed out that reference character "m," which the Examiner asserted was not mentioned in the specification, is in fact mentioned in the specification at page 13, lines 7, 11 and 24 and at page 14, lines 3 and 4.

No new matter has been added, and it is respectfully requested that the amendments to the specification be approved and entered, and that the objections to the specification and drawings be withdrawn.

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RE: THE CLAIMS AMENDMENTS

Claims 1 and 4 have been amended to clarify the features of the present invention whereby the dummy nozzle has (i) a shape for preventing ink from being ejected therefrom which includes an aperture area at an ink ejecting side thereof which is greater than an aperture area of the ejecting nozzle at an ink ejecting side thereof, and (ii) a flow impedance which is substantially the same as a flow impedance of the ejecting nozzle, wherein the flow impedance varies in accordance with both an inertial resistance of ink in the nozzle and a viscosity resistance of ink in the nozzle. And it is respectfully submitted that the amendments to claims 1 and 4 are supported by the disclosure in the specification at, for example, page 13, lines 1-9, and at page 15, lines 12-15 (and equation (2)).

In addition, claims 1-6 have been amended to make some minor grammatical improvements and to correct some minor antecedent basis problems so as to put them in better form for issuance in a U.S. patent.

No new matter has been added, and it is respectfully requested that the amendments to the claims be approved and entered.

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RE: THE PRIOR ART REJECTION

Claim 1 was rejected under 35 USC 103 as being obvious in view of the combination of USP 5,748,214 ("Usui et al") and USP 5,975,681 ("Ogasawara et al"); claims 2 and 3 were rejected under 35 USC 103 as being obvious in view of the combination of Usui et al, Ogasawara et al and USP 6,142,607 ("Takata et al"); claim 4 was rejected under 35 USC 103 as being obvious in view of the combination of Usui et al, Ogasawara et al and USP 6,431,682 ("Osada et al"); and claims 5 and 6 were rejected under 35 USC 103 as being obvious in view of the combination of Usui et al, Ogasawara et al, Osada et al and Takata et al. These rejections, however, are respectfully traversed with respect to the claims as amended hereinabove.

According to the present invention as recited in clarified amended independent claims 1 and 4, an ink jet head is provided which comprises a plurality of pressure chambers arranged in parallel, each of which is defined by side walls and communicates with an ink supplying path, wherein the plurality of pressure chambers comprise a plurality of pressure chambers in a printing region and at least one pressure chamber in a non-printing region. In addition, according to the present invention as recited in amended independent claims 1 and 4, the ink jet head comprises head driving means that selectively varies the capacity in the pressure chambers in the printing region by applying the

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driving signal to the pressure means, to eject ink from the ejecting nozzle. And when the head driving means of the ink jet head varies the capacity in a pressure chamber of the plurality of pressure chambers in the printing region which is positioned at an end of the printing region, the head driving means simultaneously varies the capacity in a corresponding pressure chamber in the non-printing region by applying a driving signal to the pressure means. With this structure, cross talk occurs at the pressure chamber in the printing region and at the pressure chamber in the non-printing region.

In order to prevent ink from being ejected from the dummy nozzle in the non-printing region, according to the present invention as recited in amended independent claims 1 and 4, the dummy nozzle has a shape for preventing ink from being ejected therefrom which includes an aperture area at an ink ejecting side thereof which is greater than an aperture area of the ejecting nozzle at an ink ejecting side thereof.

And to cause the cross talk at the pressure chamber in the non-printing region to be substantially the same as the cross talk at the pressure chamber in the printing region, according to the present invention as recited in amended independent claims 1 and 4, the dummy nozzle has a flow impedance which is substantially the same as a flow impedance of the ejecting nozzle, wherein the flow impedance varies in accordance with both

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an inertial resistance of ink in the nozzle and a viscosity resistance of ink in the nozzle.

With the structure of the present invention as recited in amended independent claims 1 and 4, it is possible to prevent variation in the volume of ink droplets occurring due to cross talk, to prevent non-uniform print density.

The Examiner asserts that Usui et al inherently discloses the feature of the present invention whereby when the head driving means varies the capacity in a pressure chamber of the plurality of pressure chambers in the printing region which is positioned at an end of the printing region, the head driving means simultaneously varies the capacity in a corresponding pressure chamber in the non-printing region.

According to the present invention as recited in clarified amended independent claims 1 and 4, however, the head driving means simultaneously varies the capacity in a corresponding pressure chamber in the non-printing region by applying a driving signal to the pressure means. (See Fig. 7.)

And it is respectfully pointed out that Usui et al discloses at column 12, lines 28-31 thereof that ink is not jetted out from the nozzles 79, "since no drive signal is applied to the dummy pressure producing chambers 71" (emphasis added). Thus, it is respectfully submitted that Usui et al clearly does not at all disclose, teach or suggest the feature of the present invention

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as recited in amended independent claims 1 and 4 whereby when the head driving means varies the capacity in a pressure chamber of the plurality of pressure chambers in the printing region which is positioned at an end of the printing region, the head driving means simultaneously varies the capacity in a corresponding pressure chamber in the non-printing region by applying a driving signal to the pressure means.

In addition, the Examiner acknowledges on page 4 of the Office Action that Usui et al does not disclose, teach or suggest the features of the present invention whereby the dummy nozzle has an aperture area at an ink ejecting side thereof which is greater than an aperture area of the ejecting nozzle at an ink ejecting side thereof and whereby the dummy nozzle has a flow impedance which is substantially the same as a flow impedance of the ejecting nozzle. For this reason, the Examiner has cited Ogasawara et al to supply the missing teachings of Usui et al.

As recognized by the Examiner, Ogasawara et al does disclose that dummy nozzles are provided which have a greater sectional area than other nozzles. However, it is respectfully pointed out that as described at column 12, lines 6-10, the flow resistance of the dummy nozzles is lowered by increasing the sectional area thereof.

Thus, it is respectfully submitted that according to Ogasawara et al the dummy nozzles have a lower flow resistance

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than the ink ejecting nozzles. And it is respectfully submitted, therefore, that Ogasawara et al clearly does not at all disclose, teach or suggest the feature of the present invention as recited in clarified amended independent claims 1 and 4 whereby the dummy nozzle has a flow impedance which is substantially the same as a flow impedance of the ejecting nozzle, and wherein the flow impedance varies in accordance with both an inertial resistance of ink in the nozzle and a viscosity resistance of ink in the nozzle.

Thus, it is respectfully submitted that the combination of Usui et al and Ogasawara et al does not at all disclose, teach or suggest the features of the present invention as recited in amended independent claims 1 and 4 whereby when the head driving means varies the capacity in a pressure chamber of the plurality of pressure chambers in the printing region which is positioned at an end of the printing region, the head driving means simultaneously varies the capacity in a corresponding pressure chamber in the non-printing region by applying a driving signal to the pressure means, and whereby the dummy nozzle has a flow impedance which is substantially the same as a flow impedance of the ejecting nozzle, and wherein the flow impedance varies in accordance with both an inertial resistance of ink in the nozzle and a viscosity resistance of ink in the nozzle.

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With respect to claims 2, 3, 5 and 6, moreover, the Examiner acknowledges on pages 5 and 8 of the Office Action that Usui et al., Ogasawara et al., and Osada et al do not disclose the features of the present invention as recited in claims 2, 3, 5 and 6 whereby an aperture diameter of the ejecting nozzle at a pressure chamber side thereof is greater than an aperture diameter at the ink ejecting side thereof, and an aperture diameter of the dummy nozzle at a pressure chamber side thereof is smaller than an aperture diameter at the ink ejecting side thereof, as recited in claims 2 and 5, and whereby the ejecting nozzle and the dummy nozzle each have symmetrical shapes with respect to an ejecting direction of an ink droplet, as recited in claims 3 and 6.

For this reason, the Examiner has cited Takata et al to supply the missing teachings of Usui et al., Ogasawara et al and Osada et al. In particular, the Examiner refers to nozzles 28a and 28b as shown in Fig. 15 of Takata et al.

As recognized by the Examiner, nozzle 28b in Fig. 15 of Takata et al does have an aperture diameter at the pressure chamber side thereof which is greater than the aperture diameter at the ink ejecting side thereof. And as recognized by the Examiner, nozzle 28a in Fig. 15 of Takata et al does have an aperture diameter at the pressure chamber side thereof which is less than the aperture diameter at the ink ejecting side thereof.

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It is respectfully pointed out, however, that both nozzles 28a and 28b of Takata et al are used to eject ink (see column 9, lines 44 to column 10, line 5 of Takata et al). Thus, it is respectfully submitted that neither of the nozzles 28a or 28b of Takata et al corresponds to the dummy nozzle of the claimed present invention, which has a shape for preventing ink from being ejected therefrom, as recited in clarified amended independent claims 1 and 4.

Accordingly, it is respectfully submitted that Takata et al does not disclose, teach or suggest the feature of the present invention as recited in claims 2 and 5 whereby an aperture diameter of the ejecting nozzle at a pressure chamber side thereof is greater than an aperture diameter at the ink ejecting side thereof, and an aperture diameter of the dummy nozzle at a pressure chamber side thereof is smaller than an aperture diameter at the ink ejecting side thereof.

Finally, it is noted that Osada et al has merely been cited for the disclosure of moving means.

In view of the foregoing, it is respectfully submitted that amended independent claims 1 and 4, and claims 2, 3, 5 and 6 respectively depending therefrom, all clearly patentably distinguish over Usui et al, Ogasawara et al, Osada et al and Takata et al, taken singly or in any combination, under 35 USC 103.

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Entry of this Amendment, allowance of the claims and the passing of this application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,



Douglas Holtz
Reg. No. 33,902

Frishauf, Holtz, Goodman & Chick, P.C.
767 Third Avenue - 25th Floor
New York, New York 10017-2023
Tel. No. (212) 319-4900
Fax No. (212) 319-5101

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